

Washington State Dept. of Transportation

WSDOT Statewide Communications Plan
Final Report

EXECUTIVE SUMMARY

March 21, 2003

1. EXECUTIVE SUMMARY

1.1 INTRODUCTION

The Washington State Department of Transportation (WSDOT) has identified the need for a Statewide Communications Plan that provides strategic direction for the management and expansion of WSDOT's communication infrastructure. Beyond the need for WSDOT offices across the state to conduct their daily business, WSDOT is known as a leader in the deployment of Intelligent Transportation Systems (ITS), and accordingly has installed as-needed communications infrastructure to support the transfer of data and video images from ITS field devices and transportation management systems. This information is used by WSDOT to monitor and manage the statewide highway system and provide the traveling public with real time travel information.

WSDOT's Light Lanes project was a recent initiative intended to deploy a 700+ mile fiber optic communications network statewide (primarily in WSDOT freeway and highway right-of-way) in order to provide a communications backbone for ITS field devices and to facilitate inter-regional information sharing. Unfortunately, with the economic collapse of the telecommunications industry, there was no longer any interest from third parties to participate in building the Light Lanes network, leaving WSDOT to look for other alternatives and setting the stage for this study.

The Technology Solutions for Transportation Operations¹, the Washington Statewide ITS Architecture, and the stakeholder interviews/literature review conducted for this Communications Plan, have all identified the need for greater center-to-center communications between WSDOT regions, the Washington State Patrol, and local municipalities; for incident management, traffic control, and improved day-to-day operations. Other recognized needs, including the deployment of additional ITS field devices and "smart" vehicle initiatives, will also require expanded center-to-field and center-to-vehicle communications. The effort has clearly identified the increasing need for a high speed and reliable communications network to support the daily operations and business functions of the Department. Thus, the purpose of the Statewide Communications Plan is to:

"Set Strategic Direction for the Implementation of a Statewide Communications Network to Serve the State Transportation Systems Management, Video, and Integrated Data Needs"

1.2 FINDINGS

An extensive review of the current, planned, and required communications infrastructure was completed as part of this effort. The findings of this review provide the basis for the development of the recommendations detailed in the Statewide Communications Plan. The findings are summarized below:

¹ Document currently under development

- **Inter-regional Communications:** Office-to-Office data and video information flows and communications requirements between one of WSDOT's six regions and the State Headquarters (HQ) in Olympia or between regional Transportation Management Centers (TMCs) constitute inter-regional communications. These information flows include enterprise and administrative functions, as well as those required to support ITS initiatives. The existing network consists primarily of communication lines leased from telecommunications providers, which are configured in a star topology radiating from Olympia to the regional headquarters and offices to serve these enterprise and administrative needs. Communications traffic between regions (voice and data) is routed from one region through Olympia HQ and back out to the other region.

These higher capacity leased line links are used for phone service and to create the WSDOT Wide Area Network (WAN). The WAN allows all connected WSDOT offices access to email, the Internet, and the WSDOT Intranet, over which many broadband applications are accessed. This network also allows transmission of highway condition camera images and data from each region for posting on WSDOT's statewide traveler information website housed at WSDOT Headquarters.

Of the inter-regional connections, currently only the link between WSDOT Headquarters and the South Central Region is at a utilization level that would result in reduced response times and performance. However, several of the other primary links are nearing this threshold. More importantly, WSDOT is concerned about network reliability and is currently very reliant on private communications providers for these leased line connections. The star topology by nature offers limited redundancy between sites, further adding to concern about network reliability.

This well managed and monitored network will require expansion in the future to accommodate additional demands. Anticipated growth in employee network use and the centralization of more Departmental applications will increase traffic on the network. These applications include expansion and centralization of performance monitoring, State Route View (SRView – which provides digital images of state routes), aerial photograph access, computer aided design applications, geographic information systems, and digitizing of construction documents.

The growth in ITS bandwidth requirements will expand as the number of cameras (both "snap shot" image and the move to full motion video) and other devices and sensors are deployed in the field and this information is transmitted to Olympia for posting on the Internet. Additionally, neighboring WSDOT regions will become increasingly interested in sharing access (and possibly control) of each other's cameras and devices, particularly as more are deployed near regional boundaries. A potential ITS development that could have serious bandwidth implications is the proposed Statewide Traffic Operations Center/Emergency Operations Center (STOC/EOC) in Olympia which would have real-time access to cameras, sensors, variable messages signs (VMS), highway advisory radio (HAR) and WSDOT Regional Traffic Management Centers (TMCs) across the state.

- **Intra-regional Communications:** Intra-regional communications include office-to-office data and video information flows and communications requirements within a given WSDOT region. These information flows include enterprise and administrative functions, as well as those required to support ITS initiatives. Lower capacity leased lines are used to link smaller WSDOT offices within the region to the WSDOT WAN. Connections may utilize dedicated point-to-point leased lines between a site and the regional HQ, or they may utilize a shared (Frame Relay) “cluster” of leased lines, where several sites share a connection back to the regional HQ. These leased lines are routed back to the Regional Headquarters and then on to Olympia. Several leased line links between Regional Headquarters and offices within the region are being utilized at rates that can result in reduced response time (network slowdown) and performance issues. Enterprise needs are expected to grow over time.

Fiber networks have been installed in some of the WSDOT regions to connect regional WSDOT TMCs with local field equipment (cameras, sensors, etc) and, in more and more cases, with local jurisdiction TMCs. These direct links to cameras and sensors provide superior transmission performance. The demand on these primarily ITS fiber networks will grow as more devices and local TMCs are added. A very limited amount of fiber has been installed by WSDOT for enterprise needs. There are some opportunities for using WSDOT owned fiber for enterprise purposes and thus reducing dependency on leased communications lines.

- **Phone/PBX Network:** WSDOT has configured and maintained a telephone network that allows interoffice dialing (between WSDOT offices) without the use of the public switched telephone network (PSTN). The primary feature of this network is the ability to use 4 digit dialing between any connected WSDOT offices in the state, eliminating long distance charges on such telephone calls. Telephone service in these WSDOT offices is provided using a PBX (Private Branch Exchange). Other smaller offices do not have 4-digit dialing and are connected directly to the PSTN. The interconnections between PBXs can be carried on leased lines or over channels on the microwave system maintained by the Washington State Patrol (WSP). The demand for voice service is primarily depended upon the size of WSDOT staff in each facility.
- **Center-to-Field Voice Communications:** WSDOT’s operations rely heavily on their 800 MHz radio network to communicate with staff in the field, whether they are maintenance personnel, construction administration, incident response or other individuals performing field design work. The 800 MHz radio network is operating near capacity. In several locations, interference from same-band digital systems is impacting performance. Plans are underway to migrate to a 700 MHz system and move toward a radio system that is interoperable with WSP.

Radio users can speak to each other because radio transmission towers are connected over a state-owned backbone microwave network that is primarily maintained by WSP. Besides WSDOT and WSP radio traffic, this microwave network is also used for data and phone communications for WSP operations. Opportunities exist to upgrade the capacity of this microwave system to provide redundant and reliable communications for both WSP and WSDOT operations, including data and PBX

traffic, and thus reduce the use of leased lines while increasing network reliability and redundancy.

- **Center-to-Field Data And Video Communications:** This communication demand centers on video and data requirements for center-to-vehicle and center-to-field devices, which are primarily ITS initiatives. For Center-to-vehicle communications, both incident response team (IRT) program and the Smart Snowplow pilot project use vehicles that are equipped with laptop computers, sensors, vehicle location devices, and wireless communication equipment to keep their dispatchers informed of current conditions and locations. As both programs expand and if video images from the field are added, the communications demand will increase. ATandT Wireless is phasing out the current CDPD service that provides communications to many of the IRT vehicles. The current 800 MHz radio system will not be able to accommodate the increase in traffic.

Communications from regional WSDOT TMCs to ITS field equipment have been established based on regional design decisions. Almost every type of communications medium has been deployed. These “last mile” connections can be the most difficult to design and deploy. This incremental and regional approach has provided WSDOT with valuable experience in multiple technologies. However, the lack of standardization can increase maintenance and operational costs. WSDOT has extensive plans to deploy more ITS field equipment throughout the state. The demand for these types of communications will grow accordingly.

- **Policy Issues:** WSDOT and WSP, under the Joint Operations Policy Statement (JOPS), have agreed to “create a coordinated and integrated wireless transportation communications [network].” While both parties have accepted this language, the key will be to translate this policy into specific actions, committees and deployable projects.

Other policy modifications could result in better standardization of design practices, consistent review of design and/or construction to ensure “best practices” are employed, and better coordination to support ongoing maintenance requirements.

- **Telecommunications Market Review:** Specifically, the goal of this activity was to identify opportunities to obtain fiber optic plant from telecommunications providers who might be willing to sell (or lease long term). The rationale was that perhaps the collapse of the telecommunications market had opened up an opportunity to purchase existing fiber and/or conduit at low cost. This fiber could then potentially be used for either center-to-center or center-to-field applications, depending on route, location, etc. Over a dozen providers have been identified as possibly owning infrastructure on key corridors of interest to WSDOT. Several are providing pricing for WSDOT info for various key circuits. 360networks has indicated an interest in possible long-term lease of dark fiber on I-5 corridor. NoaNet appears to be a “best fit” for locations, availability and pricing at this point.

1.3 RECOMMENDATIONS

This wide-ranging analysis of the existing communications networks, methods and future requirements reveals some excellent opportunities for cooperation and synergy with the promise of increased communication capacity, improved redundancy and lower operational costs. The needs and technical complexities are significant. Continuation of WSDOT's cooperative and active management will be required for success. In general terms, the WSDOT statewide communications network must serve all communication needs for daily and emergency operations with adequate capacity, redundant paths, reliable service, while being cost effective. The network should remain a hybrid network (i.e., part state owned, part leased), but one that maximizes utilization of state-owned infrastructure, including the microwave, fiber, and radio networks. WSDOT should continue to use leased line communications where cost effective or where required for redundancy. Key specific recommendations are as follows:

1. **Establish a joint WSP/WSDOT Communications Task Force:** The charge of this task force is to make strategic decisions on communications infrastructure. Activities would include a review of the existing communications infrastructure for redundancy opportunities, development of a joint plan for an ultimate network, assess build/buy/lease opportunities to obtain best arrangement for both agencies, develop a wireless subcommittee to review the design of ALL wireless construction projects, and development of necessary interagency agreements.
2. **Upgrade Microwave Backbone:** WSDOT should work together with WSP to increase the capacity of selected segments of the microwave network for data and voice service. WSDOT priorities should consider "high utilization segments", center-to-center connections for ITS, and high cost leased line segments. Specific opportunities are identified in the report.
3. **Upgrade Over-Utilized Communication Links:** Specific links that provide communications to WSDOT offices are over-utilized, resulting in a reduced level of service. Benefit/cost analysis should be performed comparing adding additional leased line capacity vs. upgrading and utilizing existing infrastructure, particularly the fiber and microwave networks. This analysis needs to compare life cycle, in addition to, initial capital construction costs. Specific opportunities are identified in the report.
4. **Review Use of WSDOT-Owned Fiber:** Analyze the WSDOT-owned fiber optic network for its capability to support WSDOT enterprise data and communication needs to for replacing leased lines. There is the potential to use existing dark fiber, reallocated fibers and electronics upgrades.
5. **Explore the 360networks Fiber Run along Interstate 5:** 360networks owns fiber optics cable near I-5 from Vancouver to Everett. 360networks has indicated an interest in long-term lease options for dark fiber and possibility of installing additional manholes or splice points if required. This could reduce the cost of leased lines along this corridor and may be able to access field devices (particularly CCTV cameras). However, it should be noted that the fiber run from Chehalis to Spanaway takes an alternate route, veering well away from I-5.

6. **Bandwidth Management for Video Traffic:** There are techniques (and equipment) that can dynamically manage the bandwidth utilized for the transmission of digital video images, which “expand or contract” the bandwidth to meet the current need, priorities and available bandwidth. These techniques could be used to reduce the demand on the communications network for the transmission of the video images to WSDOT Headquarters for placement on the WSDOT traveler information website.
7. **Use WSDOT Radio Network for Communication to Field Devices:** Look for opportunities to use the radio network to communicate with field devices that have low data requirements, instead of using leased lines with monthly fees.
8. **Upgrade the WSDOT Radio Network:** We support the Wireless Task Force recommendation to upgrade the radio network to 700 MHz. This change will provide additional capacity for voice, data to vehicle, and data to field devices, and alleviate the current interference problems. The upgrade must ensure interoperability with WSP.
9. **Formalize Policy of Installing Fiber Optic Cable as Part of New Projects:** Fiber optic cable has generally been installed as part of the Surveillance, Control and Driver Information (SCandDI) element of freeway or HOV lane widening projects in the state. This informal practice should be formalized in WSDOT design directives and considered for major reconstruction projects. Key routes should be identified and prioritized. This will reduce the dependence on leased lines and provide an alternate route for microwave traffic. This report indicates some possible high priority corridors for expanding the fiber optic networks, based primarily on density of WSDOT offices and/or field devices.
10. **Conduct I-5 Corridor Communication Analysis:** The I-5 Corridor has the potential for the biggest cost savings through detailed analysis of communications options. This corridor includes four TMCs (five including the proposed Statewide TOC), three regional headquarters, the state headquarters and the highest density of ITS devices. There are also multiple communications options, including 360networks fiber, leased line opportunities and the microwave network, that should all be included in this analysis. It is recommended that this corridor be broken down into individual segments for further lifecycle, cost/benefit analysis of communications options.
11. **Implement Asset Management System:** The current decentralized approach of documenting WSDOT communications assets does not always provide the needed information to make informed and coordinated communication infrastructure expansion decisions, while at the same time increasing effort (and cost) of maintaining the network. An asset management system should be implemented to document information concerning fiber, communications equipment, ITS devices, etc.
12. **Evaluate Satellite for Remote Sites:** The Eastern Region has begun utilizing satellite communications for data connections to remote sites (maintenance sheds) where leased line options do not exist. It is recommended that WSDOT perform further analysis of the cost and benefits of this application, and determine if it is applicable to other remote sites, particularly in North Central, South Central and possibly Olympic Peninsula.

13. **Policy for Redundancy:** WSDOT should develop a strategy and implement specific policy on redundancy requirements for communications. Several of the larger sites, including regional headquarters, TMCs, Project Engineering offices and Maintenance Area offices have been identified as requiring additional redundancy during emergencies or even simply to avoid loss of connectivity during daily activity. However, no specific policy exists on which business functions require what specific level of redundancy.
14. **Spare Capacity Guidelines:** In order to support network growth and flexibility, it is recommended that WSDOT develop a strategy on spare capacity, including a specific set of guidelines. Different levels of spare capacity are recommended for different applications, for example, it is relatively easy to add additional capacity to a leased line connection and generally does not require additional capital expense, whereas, it is much more difficult and costly to add capacity to owned infrastructure such as fiber or microwave. There are also different requirements for spare capacity in different network elements, including fiber, transmission equipment, equipment chassis, equipment racks and even floor space in communications facilities.
15. **Standardize Communications Protocols:** In order to support operations and maintenance, as well as interoperability of the network, it is recommended that WSDOT standardize on a set of specific communications protocols for various applications. Examples may include: SONET, T-1/T-3, TCP/IP, RS-232 and P25 (wireless.) WSDOT should formalize standards on NTCIP for ITS applications. WSDOT may consider standardizing on Gigabit Ethernet backbones for TCP/IP networks with specific carriers or when dark fiber is available.
16. **Coordination with Maintenance:** It is recommended that WSDOT implement a policy of closer coordination with maintenance personnel during the design and implementation of new systems. Different departments take over maintenance responsibilities of different systems, depending on the application and in some cases, the region. It is important to identify who will be maintaining the equipment on an ongoing basis, for any new implementation, and ensure that they are involved in some phase of design review. Through this process, it can be verified that they have (or can obtain) both the technical training and equipment required for ongoing maintenance. It is also important to ensure that they have assigned proper budget and staffing requirements (FTEs) for ongoing maintenance.

2. RECOMMENDATIONS

This wide-ranging analysis of the existing communication networks, methods and future requirements reveals some excellent opportunities for cooperation and synergy with the promise of increased communication capacity, improved redundancy and lower operational costs. The needs and technical complexities are significant. Continuation of WSDOT's cooperative and active management will be required for success. In general terms, the WSDOT statewide communications network must serve all communication needs for daily and emergency operations with adequate capacity, redundant paths, and reliable service, while being cost effective. The network should remain a hybrid network (i.e., part state owned, part leased), but one that maximizes utilization of state-owned infrastructure, including the microwave, fiber, and radio networks. WSDOT should continue to use leased line communications where cost effective or where required for redundancy. Key specific recommendations are as follows:

2.1 RECOMMENDATION # 1: CREATE WSDOT/WSP COMMUNICATIONS TASK FORCE

| Description | |
|---|---|
| <p>Develop a dual agency task force, including representatives from both WSDOT and WSP, whose charter is to make strategic decisions on communications infrastructure upgrades, lease/purchase options and new construction, while ensuring that both agencies' requirements are considered.</p> <p>The task force may be broken up into different committees or groups to address specific issues and requirements. For example three groups may be created within the Task Force, possibly identified as:</p> <ul style="list-style-type: none">• Customer Advisory Group: to focus on both agencies' communications needs and priorities,• Technical Advisory Group: to focus on technologies, standards and design review,• Executive (Governance) Group: to administer policy change as required, based on recommendations from the other two groups. <p>As with any effective task force within an organization, specific staff will need to be assigned the responsibility and authority required to ensure the effective implementation of any of the task force's recommendations.</p> | |
| Requirements Addressed | |
| <ul style="list-style-type: none">• Better coordination between WSDOT and WSP• Microwave network design, upgrade and maintenance• Procurement of new telecom services• Design review for all wireless construction• Provide cost effective network | |
| Implementation Notes | Impact Areas |
| <p>The following are potential tasks that the Task Force will undertake:</p> <ol style="list-style-type: none">1. Review existing communications infrastructure for redundancy opportunities2. Develop WSDOT/WSP long term and migration plan for the dual-agency network. WSDOT's priorities for upgrade may include high-utilization segments, Center-to-Center connections for ITS, and high-cost leased-line segments.3. Review each deployment for compliance with plan4. Review build/buy/lease arrangements to obtain best value | <ul style="list-style-type: none">• Inter-regional Communications• Intra-regional Communications• Policy Issues |

| | |
|--|--|
| <div>5. Develop necessary agreements.</div> <div>6. Develop a Wireless Subcommittee to review the planning and design of all wireless construction projects.</div> <div>7. Review “siting” of field equipment to ensure that opportunities for collocation and other efficiencies (line of site, power, etc) are maximized.</div> <div>Consider starting with the Statewide Communications Plan Task Force and growing as appropriate.</div> | <div>Correlation with Other Recommendations</div> <div><ul style="list-style-type: none">#2 – Upgrade Microwave Backbone</div> |
|--|--|

2.2 RECOMMENDATION # 2: UPGRADE MICROWAVE BACKBONE

Description

Work together with WSP to upgrade key segments of Microwave segments to OC3. Figure 21 illustrates the segments of the microwave network that WSP has identified as priorities to upgrade in order to complete three OC3 rings.

Requirements Addressed

- Better redundancy for key inter-regional connections
- Upgrade segments that are at/near capacity
- New connections to WSP
- Upgrade microwave backbone as voice traffic increases.
- Support growing bandwidth requirements on existing links
- Need selected center-to-center TMC ITS links
- New Statewide Traffic Operations Center
- Provide cost effective network

Implementation Notes

The upgraded microwave network will be used for data and voice and possibly video. In addition to the expanded bandwidth, the upgrade will help to improve redundancy for key connections.

WSDOT should prioritize their communications requirements, to be able to work more effectively with WSP, particularly, to be able to quantify the bandwidth requirements and the type of communication (data, voice, video) to be supported.

Jointly, the agencies may be able to identify opportunities to modify and improve the plan illustrated in Figure 21. For example, state owned sites may be identified as preferable to any leased sites that may be indicated in the figure.

Upgrade requirements to equipment, towers, facilities and/or cable plant should all be taken into account, along with agency communications needs, when determining the final paths and associated sites to be upgraded.

Impact Areas

- Inter-regional Communications
- Intra-regional Communications
- Center-to-Field Voice
- PBX Network

Correlation with Other Recommendations

- #1 – WSP/WSDOT Communications Task Force

2.3 RECOMMENDATION # 3: UPGRADE OVER-UTILIZED COMMUNICATIONS LINKS

| Description | |
|---|---|
| Specific links that provide communications to WSDOT offices are over-utilized, resulting in a reduced level of service. Benefit/cost analysis should be performed comparing adding additional leased line capacity vs. upgrading and utilizing existing infrastructure, particularly the fiber and microwave networks. This analysis needs to compare life cycle, in addition to, initial capital construction costs. | |
| Requirements Addressed | |
| <ul style="list-style-type: none"> Better redundancy for key inter-regional connections Upgrade segments that are at/near capacity | |
| Implementation Notes | Impact Areas |
| <p>Figure 6 is a graph illustrating current bandwidth utilization rates of all of the key Inter-regional connections, i.e., between WSDOT HQ in Olympia and the regional HQs.</p> <p>Figure 16 is a graph illustrating the moderate and high utilization Intra-regional connections.</p> <p>Figure 28 through Figure 36 illustrate some examples of potential microwave paths, which may be upgraded to be able to replace or augment the leased line connections at many of these “high utilization” segments. Figure 37 also illustrates the existing fiber network in the NW region.</p> <p>It is recommended that upgrade of these segments of owned infrastructure (microwave and fiber) be considered and compared (cost/benefit analysis using life cycle costs) with leased line options, as WSDOT decides to upgrade these segments.</p> <p>It should be noted, that the upgrades that are currently underway with NoaNet and Quest (as described in section 3.1.4 and illustrated in Figure 7Error! Reference source not found.) should go a long way toward addressing many of these high utilization segments, particularly the Inter-Regional segments.</p> | <ul style="list-style-type: none"> Inter-regional Communications Intra-regional Communications |
| | Correlation with Other Recommendations <ul style="list-style-type: none"> #2 – Upgrade Microwave Backbone #4 – Review WSDOT-owned Fiber Capability to Support IT #5 – Explore options with 360networks fiber on I-5 |

2.4 RECOMMENDATION # 4: REVIEW AVAILABILITY OF WSDOT FIBER FOR USE BY IT/IS

| Description | |
|--|---|
| <p>WSDOT has an extensive fiber optic network in the Northwest Region and growing networks in other regions including Olympic, Southwest, and Eastern. These networks, built originally to support ITS communications, should be analyzed for potential to support WSDOT's wider communications needs including ITS, as well as, administrative and IT/IS data, video and voice requirements.</p> | |
| Requirements Addressed | |
| <ul style="list-style-type: none"> • Need selected Center-to-Center TMC ITS links • New Statewide Traffic Operations Center • Provide cost effective network | |
| Implementation Notes | Impact Areas |
| <p>As with many regions around North America who were earlier implementers of ITS technologies, the WSDOT Northwest Region's fiber network was designed and implemented utilizing technology (and associated architecture) that was considered "state of the art" at the time.</p> <p>Advances in communications technology have lead to much more efficient utilization of infrastructure, most notably fiber optic plant. Nowhere is this more evident than in the transport of video signals from a field device (CCTV camera) back to the TMC. Older technology often required dedicating an entire fiber to a single camera. Advanced in multiplexing, digitize and compression technologies, now offer the ability to combine and transport many signals (as well as data) on a single fiber.</p> <p>It is recommended that WSDOT review their fiber networks for opportunities to optimize network utilization, thus freeing up fiber to be used for other communications needs. The review should consider existing dark fiber, "re-grooming" of lit fiber, and any associate electronics and optronics upgrades as required. The cost of these upgrades and the regrooming efforts could then be shared between the IT department and the ITS group as appropriate.</p> | <ul style="list-style-type: none"> • Inter-regional Communications • Intra-regional Communications |
| | <p>Correlation with Other Recommendations</p> <ul style="list-style-type: none"> • #1 – WSP/WSDOT Communications Task Force • #3 – Upgrade Over-utilized Communications Links • #9 – Formalize Fiber Policy for New WSDOT Construction Projects |

2.5 RECOMMENDATION #5: EXPLORE OPTIONS TO LEASE 360NETWORKS FIBER ON I-5 AND EXPLORE OPPORTUNITIES WITH OTHER PROVIDERS

| Description | |
|---|--|
| <p>360networks has expressed interest in long-term lease options for dark fiber currently running from Vancouver to Everett. 360networks also indicated possibility of installing additional manholes or splice points if required. This opportunity should be further analyzed.</p> <p>Additional telecommunications market research may also identify other providers willing to offer long-term lease or dark fiber sales.</p> | |
| Requirements Addressed | |
| <ul style="list-style-type: none"> • Need selected Center-to-Center TMC ITS links • New Statewide Traffic Operations Center • Support growing bandwidth requirements (specifically, video) • Provide enterprise-wide communications solutions • Provide cost effective network | |
| Implementation Notes | Impact Areas |
| <p>One of WSDOT's desires in this study was to see if any telecommunications providers were willing to sell and/or enter into long term lease agreement on, dark fiber along WSDOT's key corridors. This fiber could then potential be used for both center-to-center and center-to-field communications.</p> <p>At the time that this study was completed, only 360 networks had indicated interest in a long-term lease or 20-year IRU (Indefeasible Right-of-Use) agreement, for two fibers along the I-5 corridor, primarily from Vancouver to Everett.</p> <p>Appendix D illustrates 360 networks approximate fiber route along this corridor (note: No fiber along stretch of I-5 between Chehalis and Spanaway, as it follows a separate route up to several miles away from I-5.)</p> <p>Appendix E includes a sample 360networks agreement letter, including a preliminary fee estimate for the IRU. It should be noted that 360networks provided this estimate as a "lump sum" (or capitol cost) for the 20-year IRU (as requested.) 360networks indicated that this agreement could be easily structured in monthly payments.</p> <p>It should be noted that this telecommunications market review was not a significant portion of the overall Statewide Communications Plan and therefore was not an "exhaustive" exercise. Oregon DOT has apparently had more success with other telecommunications providers and may be able to provide additional contacts.</p> | Correlation with Other Recommendations |
| | <ul style="list-style-type: none"> • Inter-regional Communications • #1 – WSP/WSDOT Communications Task Force • #4 – Review WSDOT-owned Fiber Capability to Support IT • #9 – Formalize Fiber Policy for New WSDOT Construction Projects |

2.6 RECOMMENDATION # 6: BANDWIDTH MANAGEMENT FOR VIDEO

| Description | |
|---|---|
| <p>There are techniques (and equipment) that can dynamically manage the bandwidth utilized for the transmission of digital video images, which “expand or contract” the bandwidth to meet the current need, priorities and available bandwidth. These techniques could be used to reduce the demand on the communications network for the transmission of the video images to WSDOT Headquarters for placement on the WSDOT traveler information website.</p> | |
| Requirements Addressed | |
| <ul style="list-style-type: none"> • Support growing bandwidth requirements. • Increased center-to-field communications requirements. • Increase spare capacity | |
| Implementation Notes | Impact Areas |
| <p>Bandwidth management is a phrase that is gaining increasing popularity with IT professionals, and encompasses a set of technologies and techniques that have great promise to more effectively and efficiently utilize existing communications infrastructure and investment. Many of these techniques and technologies should be considered for further evaluation by WSDOT.</p> <p>Bandwidth management (BWM) tools can prioritize data traffic based on user defined “classes”, to ensure that high priority communications traffic can not be bottlenecked by lower priority traffic (a technique known as class based queuing or CBQ). Other BWM products allocate bandwidth based on the usage by individual data flows (a technique known as “fair queuing.”) Still others involve matching the type and speed of a given data stream to the specific “receiving” connection available, whether it be 28.8K modem, T1 line, etc. Technologies in BWM continue to improve and some products now combine this bandwidth matching functions with the data prioritization functions.</p> <p>One type of implementation of bandwidth management that could prove very beneficial to WSDOT could be the implementation of a digital video distribution system, to better manage flow of video information to other municipalities and to the general public. A system like this would be fully digital, providing video in a range of bandwidth options, by varying the resolution (from still frame capture to 5 to 30 frames per second), based on available bandwidth. The system would then match the output based on the receiving entities bandwidth capabilities. Many other applications are available that should be further analyzed.</p> | Correlation with Other Recommendations |
| | <ul style="list-style-type: none"> • Center-to-Field Video • #1 – WSP/WSDOT Communications Task Force • #4 – Review Adequacy of WSDOT Fiber Available for IT |

2.7 RECOMMENDATION # 7: USE RADIO FOR FIELD DEVICES

| Description | |
|---|---|
| Look for opportunities to use the radio network to communicate with field devices instead of leased line communications. Opportunities may exist with the current 800MHz radio network, particularly for low data devices and/or remote areas. Many more opportunities will become available if and as WSDOT migrates to 700MHz band. | |
| Requirements Addressed | |
| <ul style="list-style-type: none"> • Increase center-to-field bandwidth availability • Provide cost effective network | |
| Implementation Notes | Impact Areas |
| <p>Current 800MHz Network Identify specific opportunities within each region where field devices that are currently utilizing leased line communications (especially dial-up service) may be able to be replaced using the existing radio communications network.</p> <p>Particular sensitivity needs to be placed on ensuring that the 800MHz network is not over-burdened, as voice communications to field personnel are considered top priority, mission critical services. Accordingly, opportunities may only be available for devices that require very low data transfer rates (such as turning beacons on and off) and/or devices that are located in remote areas, where there is very little voice traffic on the radio network.</p> <p>Analysis should include cost comparison of life cycle leased line cost vs. equipment upgrade, maintenance requirements, bandwidth limitations and coverage/interference issues. Figure 20 illustrates the WSDOT Radio network, including the identification of areas of poor coverage and interference.</p> <p>Future 700MHz Network Migration to the 700MHz band promises to extensively increase bandwidth availability. WSDOT should perform an inventory of ITS field devices (existing and proposed) within each region, as well as assigning bandwidth requirements to each device type. This inventory should then be considered during network deployment, to identify opportunities to expand utilization of the radio network to communicate with field devices.</p> | <ul style="list-style-type: none"> • Center-to-Field Data • Center-to-Field Voice |
| | Correlation with Other Recommendations |
| | <ul style="list-style-type: none"> • #8 – Radio Upgrade |

2.8 RECOMMENDATION # 8: RADIO UPGRADE

| Description | |
|---|--|
| Support Wireless Task Force recommendation to upgrade radio network to 700 MHz band. | |
| Requirements Addressed | |
| <ul style="list-style-type: none"> • Need to upgrade 800MHz radio network due to interference with NexTel • Increased center-to-vehicle bandwidth availability • Increase center-to-field bandwidth availability • Create redundant connections between all regional HQ and regional Maintenance Area Offices | |
| Implementation Notes | Impact Areas |
| <p>This recommendation addresses interference problems with NexTel and provides additional bandwidth for data to vehicles and field devices. The analysis of this option must be finalized and a phased implementation plan and “exit strategy” developed.</p> <p>Consider trying to negotiate with NexTel for a “fee for spectrum” to help offset the costs of this upgrade and migration. NexTel and other carriers have been known to help share the cost for other agencies to migrate out of the 800MHz spectrum, but it will require negotiation.</p> <p>While WSP does not plan on migrating their voice radio to the 700Mhz band, they have show interest in utilizing the 700 band for data communications to support applications such as email and Internet access to the vehicle, including transfer of records to the vehicle.</p> | <ul style="list-style-type: none"> • Center-to-Field Data • Inter-regional Communications • Center-to-Field Voice |
| | Correlation with Other Recommendations |
| | <ul style="list-style-type: none"> • #1 – WSP/WSDOT Communications Task Force • #7 – Use Radio for Field Devices |

2.9 RECOMMENDATION # 9: FORMALIZE FIBER POLICY FOR NEW WSDOT CONSTRUCTION PROJECTS

| Description | |
|---|---|
| Formalize policy of installing fiber along any roadway widening or “HOV lane addition” projects. To support this, key routes should be identified and prioritized and standards for installation of fiber and/or conduit for WSDOT communication should be developed and implemented. | |
| Requirements Addressed | |
| <ul style="list-style-type: none"> • Better documentation of infrastructure and asset management • Support growing bandwidth requirements • Provide cost effective network | |
| Implementation Notes | Impact Areas |
| <p>WSDOT currently has an informal policy in place to install conduit and/or fiber in specific roadway widening and HOV projects. This is a very valuable practice, as the incremental cost of installing infrastructure during and existing construction project is many times lower than the cost of deploying a “stand alone” communications infrastructure installation project. However, since WSDOT does not have a formal policy in place, the installation of communications infrastructure is often considered an expendable item, which is then often cut from the project when budgets are tight.</p> <p>It is recommended that WDOT formalize this policy by assigning specific “priority corridors” for infrastructure installation and develop standards for installation of fiber and/or conduit in these corridors. Figure 37 through Figure 41 include maps of “ITS device densities” and may be utilized to help prioritize these corridors. The maps illustrate segments of WSDOT roadway and classify them as “Very High ITS Device” density, “High ITS Device” density or no classification (which therefore indicates lower density of devices.) Figure 37 Error! Reference source not found.and Figure 39 also indicate a high density of WSDOT offices, which should also be considered in corridor prioritization.</p> <p>There is considerable flexibility in the way that WSDOT ultimately chooses to assign corridor prioritization. For example, it may be determined that any corridor of “Very High Device” density be considered as mandatory fiber installation, while any corridor of “High ITS Device” density be considered “conduit only” or even “optional based on budget availability.” Whatever the decision, clear guidelines and specific standards should be developed and the policy should be widely enforced.</p> | <ul style="list-style-type: none"> • Policy Issues |
| | <p>Correlation with Other Recommendations</p> <ul style="list-style-type: none"> • #1 – WSP/WSDOT Communications Task Force • #4 – Review WSDOT-owned Fiber Capability to Support IT |

2.10 RECOMMENDATION # 10: CONDUCT I-5 CORRIDOR COMMUNICATION ANALYSIS

| Description | | |
|--|---|--|
| Develop, compare and price alternative methods for providing communication services along I-5 corridor. | | |
| Requirements Addressed | | |
| <ul style="list-style-type: none"> • Provide enterprise-wide communications solutions • Need Selected Center-to-Center TMC ITS Links • New Statewide Traffic Operations Center • Support growing bandwidth requirements (specifically, video) • Better redundancy for key inter-regional connections • Provide cost effective communications | | |
| Implementation Notes | Impact Areas | |
| <p>Examine Seattle to Olympia and Olympia to Vancouver segments.</p> <p>Conduct detailed analysis of life-cycle cost trade-off between leasing, microwave, and new fiber construction</p> <p>Recommended Tasks Include:</p> <ol style="list-style-type: none"> 1. Investigate specific routes and connectivity requirements with vendors to determine availability of services 2. Solicitation of firm quotes from selected telecommunication service providers 3. Development of complete cost comparisons including existing leased lines, potential dark fiber providers and extension of a state-owned fiber network. This analysis should consider capital costs, operating expenses, and life cycle replacements. | <ul style="list-style-type: none"> • Inter-regional Communications • Intra-regional Communications • Center-to-Field Voice • PBX Network | |
| | <th>Correlation with Other Recommendations</th> | Correlation with Other Recommendations |
| | <ul style="list-style-type: none"> • #2 – Upgrade Microwave Backbone • #4 – Review Adequacy of WSDOT Fiber Available for IT • #5 – Explore options with 360networks fiber on I-5 | |

2.11 RECOMMENDATION # 11: IMPLEMENT ASSET MANAGEMENT POLICY

| Description | |
|--|---|
| Develop a policy and procedures for Asset Management. | |
| Requirements Addressed | |
| <ul style="list-style-type: none"> Better documentation and asset management | |
| Implementation Notes | Impact Areas |
| <p>The first implementation stage to this recommendation would determine the range of assets that should be managed. This determination must consider the cost of recording and maintaining each group of devices, and cost effective methods to record and maintain a current inventory of the designed equipment and associated information.</p> <p>Potential information to be included in the Asset Management system:</p> <ul style="list-style-type: none"> Fiber, communications equipment, ITS devices, etc. Include location, type of device, part number, warrantee info, and maintenance information. All part assignments and use of communication channels. Include communications connections type and cost. <p>The second stage of implementation would develop high-level procedures for the initial data collection and/or input, to add assets acquired under capital projects, and to maintain current records in the event of maintenance and repair activities.</p> <p>This recommendation should also consider the technologies and hardware required to implement, maintain, and provide user access to the Asset Management System.</p> <p>It is understood that WSDOT currently has an asset inventory tool, however the extent to which it is utilized, and the features that it includes are not fully known. This existing tool should be investigated as part of this effort.</p> | <ul style="list-style-type: none"> Policy Issues |
| | <p>Correlation with Other Recommendations</p> <ul style="list-style-type: none"> #1 – WSP/WSDOT Communications Task Force |

2.12 RECOMMENDATION # 12: EVALUATE SATELLITE FOR REMOTE SITES

| Description | |
|---|--|
| Evaluate findings from Eastern Region test use of satellite to remote field offices. | |
| Requirements Addressed | |
| <ul style="list-style-type: none"> • Provide enterprise-wide communications solutions • Provide redundant connections between all regional HQ and all regional maintenance area offices. | |
| Implementation Notes | Impact Areas |
| <p>Eastern Region plans on upgrading up to 16 maintenance sheds to include network connectivity utilizing satellite broadband connections. WSDOT has tested these satellite broadband connections at several sites, and has decided to proceed with full-scale deployment.</p> <p>Eastern Region investigated other options for replacing the dial-up service to these maintenance sheds (many of which were at 28.8K speeds), but found that in most cases satellite broadband was the only option, due to service availability. Rather than split their network between some DSL, some cable broadband and some satellite, they decided to standardize as much as possible with one vendor and one solution.</p> <p>It is recommended that WSDOT review the results of this implementation with Eastern Region, and determine if it is a viable solution for remote sites in other regions, particularly North and South Central.</p> | <ul style="list-style-type: none"> • Inter-regional Communications |
| | Correlation with Other Recommendations <ul style="list-style-type: none"> • #1 – WSP/WSDOT Communications Task Force |

2.13 RECOMMENDATION # 13: REDUNDANCY

| Description | |
|--|---|
| Develop a standard strategy to implement redundancy to larger offices. | |
| Requirements Addressed | |
| <ul style="list-style-type: none"> • Reliability • Flexibility • Better redundancy for key inter-regional connections • Provide cost effective communications | |
| Implementation Notes | Impact Areas |
| <p>Establish a policy for providing redundancy</p> <p>Set requirements for use of multiple technologies (e.g., microwave, leased lines, VoIP)</p> <p>This recommendation calls for the development of standards that establish which facilities require redundancy. The standards should consider size of the office, types of applications, and cost effectiveness. The standards should be developed for application at any time in the future (as conditions change), not just a one-time determination of facilities requiring redundancy.</p> <p>The strategy for redundancy should also address the types of redundancy that are available, including;</p> <ul style="list-style-type: none"> - route redundancy - equipment redundancy - redundant technologies - “emergency” backups that may not provide redundancy for 100% of the network loading | <ul style="list-style-type: none"> • Network Policy |
| | Correlation with Other Recommendations |
| | <ul style="list-style-type: none"> • #1 – WSP/WSDOT Communications Task Force • #2 – Upgrade Microwave Backbone • #8 – Radio Upgrade |

2.14 RECOMMENDATION # 14: SPARE CAPACITY GUIDELINES

| Description | |
|--|---|
| Establish guidelines for spare capacity in WSDOT-owned networks. | |
| Requirements Addressed | |
| <ul style="list-style-type: none"> • Flexibility • Provide cost effective communications | |
| Implementation Notes | Impact Areas |
| <p>Spare levels for a number of different aspects of the network should be developed, including:</p> <ul style="list-style-type: none"> • Bandwidth in the provisioned network. • Space in Equipment Chassis to provide additional cards for increased capacity. • Spare fibers or twisted pairs in cables that are installed underground. • Space for expansion in buildings, equipment racks and field cabinets <p>Different spare capacity guidelines could be developed according to expected growth areas, and recognize technologies of different life cycles.</p> | <ul style="list-style-type: none"> • Network Policy |
| | Correlation with Other Recommendations <ul style="list-style-type: none"> • #1 – WSP/WSDOT Communications Task Force • #9 – Formalize Fiber Policy for New WSDOT Construction Projects |

2.15 RECOMMENDATION # 15: COMMUNICATION PROTOCOLS

| Description | |
|---|--|
| Adopt standard communication protocols for WSDOT applications and equipment. | |
| Requirements Addressed | |
| <ul style="list-style-type: none"> Equipment Standards Communication Standards | |
| Implementation Notes | Impact Areas |
| <p>Adopt standard communication protocol to reduce the complexity of the network. The following protocols are recommended:</p> <ul style="list-style-type: none"> TCP/IP networks should be used for the majority of the lower speed (10/100Mbps) connections. High-speed communication should use SONET transmission standards. This equipment can be fed with the T1 and DS-3 signals standard to the telephone industry. Where networks carry TCP/IP traffic only, consideration should be given to the use of Gigabit Ethernet for backbone communication. Low speed data circuits (primarily for ITS applications) can use EIA/TIA 232 or TCP/IP. All ITS interfaces should adhere to NTCP/IP standards where they have been accepted. All data interfaces should use EIA/TIA 232 and/or Ethernet protocols, which will support NTCIP standards. Consider the use of Gigabit Ethernet for TCP/IP is used and dark fiber is available | <ul style="list-style-type: none"> Network Policy |
| | Correlation with Other Recommendations <ul style="list-style-type: none"> #1 – WSP/WSDOT Communications Task Force |

2.16 RECOMMENDATION # 16: COORDINATION WITH MAINTENANCE

| Description | |
|--|--|
| Implement a policy of closer coordination with Maintenance during the design and implementation of communications projects. The intent of this policy should be to ensure early identification of the group or individuals who will be responsible for the on-going maintenance and operations of the communications infrastructure. Once the proper parties have been identified, effort should also be made to make sure that they have been included in the design review process and that they have the proper tools and training for ongoing infrastructure Operations and Maintenance. | |
| Requirements Addressed | |
| <ul style="list-style-type: none"> • Equipment Standards • Communication Standards • Provide cost effective communications | |
| Implementation Notes | Impact Areas |
| <ol style="list-style-type: none"> 1. Identify who will be maintaining the equipment (may vary by network component). 2. Review system design with maintenance personnel at appropriate point in design process. 3. Ensure that maintenance personnel have the necessary technical training and equipment to support ongoing O & M, and if not, 4. Investigate opportunities for contracted maintenance where most applicable, particularly with fiber optic plant. 5. Consider procuring the equipment needed to maintain the networks built under capital contracts as “test equipment supplied by the contractor” for these projects. 6. Review maintenance budget and assigned FTEs to ensure that O & M is supported. | <ul style="list-style-type: none"> • Network Policy |
| | Correlation with Other Recommendations <ul style="list-style-type: none"> • #1 – WSP/WSDOT Communications Task Force |